

What is claimed is:

1. A capacitor comprising:

a lower electrode having a structure in which a first conductive layer containing a first metal, a second conductive layer that is formed on the first conductive layer and made of a metal oxide of a second metal different from the first metal, and a third conductive layer that is formed on the second conductive layer and made of a third metal different from the first metal are formed sequentially on an insulating layer;

a dielectric layer formed on the lower electrode; and

an upper electrode formed on the capacitor dielectric layer.

2. A capacitor according to claim 1, wherein the first metal is iridium, the metal oxide of the second metal is a metal oxide of a platinum group metal except the iridium, and the third metal is the platinum group metal except the iridium.

3. A capacitor according to claim 1, wherein the second metal is a same element as the third metal, and an interface conductive layer made of the second metal is further formed between the first conductive layer and the second conductive layer.

4. A capacitor according to claim 3, wherein the second metal is platinum.

5. A capacitor according to claim 1, wherein the

first conductive layer contains iridium or ruthenium and has a function for preventing diffusion of oxygen, and

the second conductive layer has a function for preventing diffusion of the iridium or the ruthenium.

5 6. A capacitor according to claim 1, wherein the second metal is platinum, and the second conductive layer is a platinum oxide layer.

10 7. A capacitor according to claim 1, wherein the third metal is platinum, and the third conductive layer is a platinum layer.

15 8. A capacitor according to claim 1, wherein the first conductive layer is a stacked layer in which a first metal layer and a first metal oxide layer are formed sequentially.

15 9. A capacitor according to claim 8, wherein the first metal layer is an iridium layer and the first metal oxide layer is an iridium oxide layer.

20 10. A capacitor according to claim 9, wherein an iridium oxide is represented by IrO_x ($0 < x < 1.2$).

20 11. A capacitor according to claim 1, wherein the dielectric layer is any one of a ferroelectric layer and a high-dielectric layer.

25 12. A capacitor according to claim 1, further comprising a substrate, an insulating layer formed above the substrate, and an electrode plug buried in the insulating layer, and

wherein the lower electrode is formed on the

electrode plug.

13. A manufacturing method of a capacitor comprising the steps of:

5 forming a first conductive layer containing a first metal on an insulating layer;

forming a second conductive layer made of a metal oxide of a second metal, that is different from the first metal, on the first conductive layer;

10 forming a third conductive layer made of a third metal, that is different from the first metal, on the second conductive layer;

forming a dielectric layer on the third conductive layer;

15 forming a fourth conductive layer on the dielectric layer;

patternning the fourth conductive layer to form a capacitor upper electrode;

patternning the dielectric layer to form a capacitor dielectric layer; and

20 patternning the first conductive layer, the second conductive layer, and the third conductive layer to form a capacitor lower electrode.

14. A manufacturing method of a capacitor according to claim 13, wherein an element of the first metal is iridium, a metal oxide of the second metal is a metal oxide of a platinum group, that is different from the iridium, and the third metal is a metal of the platinum

group, that is different from the iridium.

15. A manufacturing method of a capacitor according to claim 13, wherein the second metal is a same element as the third metal, and

5 further comprising the step of forming an interface conductive layer made of the second metal between the first conductive layer and the second conductive layer.

10 16. A manufacturing method of a capacitor according to claim 13, wherein formation of the first conductive layer contains the step of forming the first metal layer and the first metal oxide layer sequentially.

15 17. A manufacturing method of a capacitor according to claim 16, wherein the first metal layer is an iridium layer, and the first metal oxide layer is iridium oxide, and

the iridium oxide is formed by adjusting an oxygen gas and an inert gas in a growth atmosphere to attain IrO_x ($0 < x < 1.2$).

20 18. A manufacturing method of a capacitor according to claim 13, wherein, in the step of forming the second conductive layer, the second conductive layer made of platinum oxide is formed at a temperature of more than 200 °C and less than 400 °C.

25 19. A manufacturing method of a capacitor according to claim 13, wherein, in the step of forming the third conductive layer, the third conductive layer made of platinum is formed at a temperature of less than 400 °C.

20. A semiconductor device comprising:

a transistor formed on a semiconductor substrate, and having a gate electrode and source/drain diffusion layers formed in the semiconductor substrate on both sides of the gate electrode;

5 an insulating layer for covering the transistor;

an electrode plug buried in the insulating layer and connected electrically to the source/drain diffusion layer; and

10 a capacitor formed on the electrode plug, and having a lower electrode that has a first conductive layer containing iridium, a second conductive layer formed on the first conductive layer and made of a metal oxide of a platinum group except the iridium and a third conductive layer formed on the second conductive layer and made of a metal of the platinum group except the iridium, a capacitive dielectric layer that is formed on the lower electrode by sputtering, and an upper electrode that is formed on the capacitive dielectric layer, and the lower electrode is connected electrically to the electrode plug.

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20. A semiconductor device according to claim 20, wherein the second conductive layer is a platinum oxide layer.

25. A semiconductor device according to claim 20, wherein the third conductive layer is a platinum layer.

23. A semiconductor device according to claim 20, wherein the first conductive layer is a stacked layer

consisting of an iridium layer and an iridium oxide layer formed on the iridium layer.

24. A semiconductor device according to claim 20, wherein an interface conductive layer made of a metal of a platinum group, that is different from the iridium, is formed between the first conductive layer and the second conductive layer.

25. A semiconductor device according to claim 24, wherein the interface conductive layer is platinum.

10 26. A semiconductor device comprising:

a transistor formed on a semiconductor substrate, and having a gate electrode and source/drain diffusion layers formed in the semiconductor substrate on both sides of the gate electrode;

15 an insulating layer for covering the transistor;

an electrode plug buried in the insulating layer and connected electrically to the source/drain diffusion layer; and

20 a capacitor formed on the electrode plug, and having a lower electrode that has a first conductive layer containing iridium and for preventing diffusion of oxygen, a second conductive layer formed on the first conductive layer and for preventing diffusion of the iridium from the first conductive layer and a third conductive layer formed on the second conductive layer and made of a metal of a platinum group except the iridium, a capacitor dielectric layer that is formed on the lower electrode by

sputtering, and an upper electrode that is formed on the capacitor dielectric layer, and the lower electrode is connected electrically to the electrode plug.

27. A semiconductor device according to claim 26,
5 wherein the second conductive layer is a platinum oxide layer.

28. A semiconductor device according to claim 26,
wherein the third conductive layer is a platinum layer.

29. A semiconductor device according to claim 26,
10 wherein the first conductive layer is a stacked layer
consisting of an iridium layer and an iridium oxide layer
formed on the iridium layer.

30. A semiconductor device according to claim 26,
wherein an interface conductive layer made of a metal of
15 a platinum group, that is different from the iridium, is
formed between the first conductive layer and the second
conductive layer.

31. A semiconductor device according to claim 30,
wherein the interface conductive layer is platinum.